Space Weather Technical Forecast

Issued on Saturday, 10 September 2022 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the past 24 hours, with GOES16/17 X-ray activity showing occasional low-magnitude C-class flares. The largest of these flares was a C2.6 likely originated from AR3100 Cso/Beta at 10/1119 UTC. There are currently seven numbered and one unnumbered regions on the visible disc Most regions are small stable, or showing signs of decay, although two regions are showing some signs of growth. AR3100 has some weak emergence amongst its surrounding plage area, and a small unnumbered emergent flux region in the northwest disk is still showing signs of growth. Coronagraph imagery appeared to show a faint, slow, fairly wide possible CME from off the northwest of the solar disc on the 9th. However, there is no obvious Earth sided source. A filament disappearance occurred a couple of hours after the CME, and hence cannot be the source. There is no evidence of any other Earth-directed Coronal Mass Ejections (CMEs).

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was indicative of receding fast wind from CH20/+m with some influence possible from CH24/+. The solar wind speed was slightly elevated between 400-450 km/s, with below average density. The interplanetary magnetic field (IMF), Bt, was at background, below 7nT. The north-south component Bz, showed period rotation between +5 and -6nT. The phi angle was mainly away from the Sun (positive). Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, was at Background levels, although did rise very slightly, to peak 1.17pfu at 10/1030 UTC. The high energy electron flux (greater than 2 MeV) was persistently High, peaking 1.18e4 pfu at 09/1555UTC. The 24-hour electron fluence remained above Active (1e8 integrated pfu) with 3.85e8 integrated pfu observed at 10/0000UTC, but has been rising again since reaching this minimum.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low, but with a slight chance of rising to Moderate with isolated M-class flares. This risk has the potential to increase on day 2 onward, as ex-AR3088 returns towards the southeast limb.

Solar Wind / Geomagnetic Activity: The CME from the 9th may give a slight glancing impact on day 5 (14th), just beyond this forecast period however this is very low confidence and unlikely to be significant due to the CMEs weak nature. Current influence of the fast winds of CH20/+ and CH24/+ is expected to ease, with solar winds expected to be slightly elevated to background for the forecast period. By the end of day 4 (13th) the small CH22/- could begin to enhance solar winds a little but this is low confidence. Geomagnetic activity is expected to be Quiet to Unsettled (Kp 3) at first with a slight chance of Active, probably trending predominantly Quiet (Kp 0 to 2).

Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels. The high energy (greater than 2 MeV)

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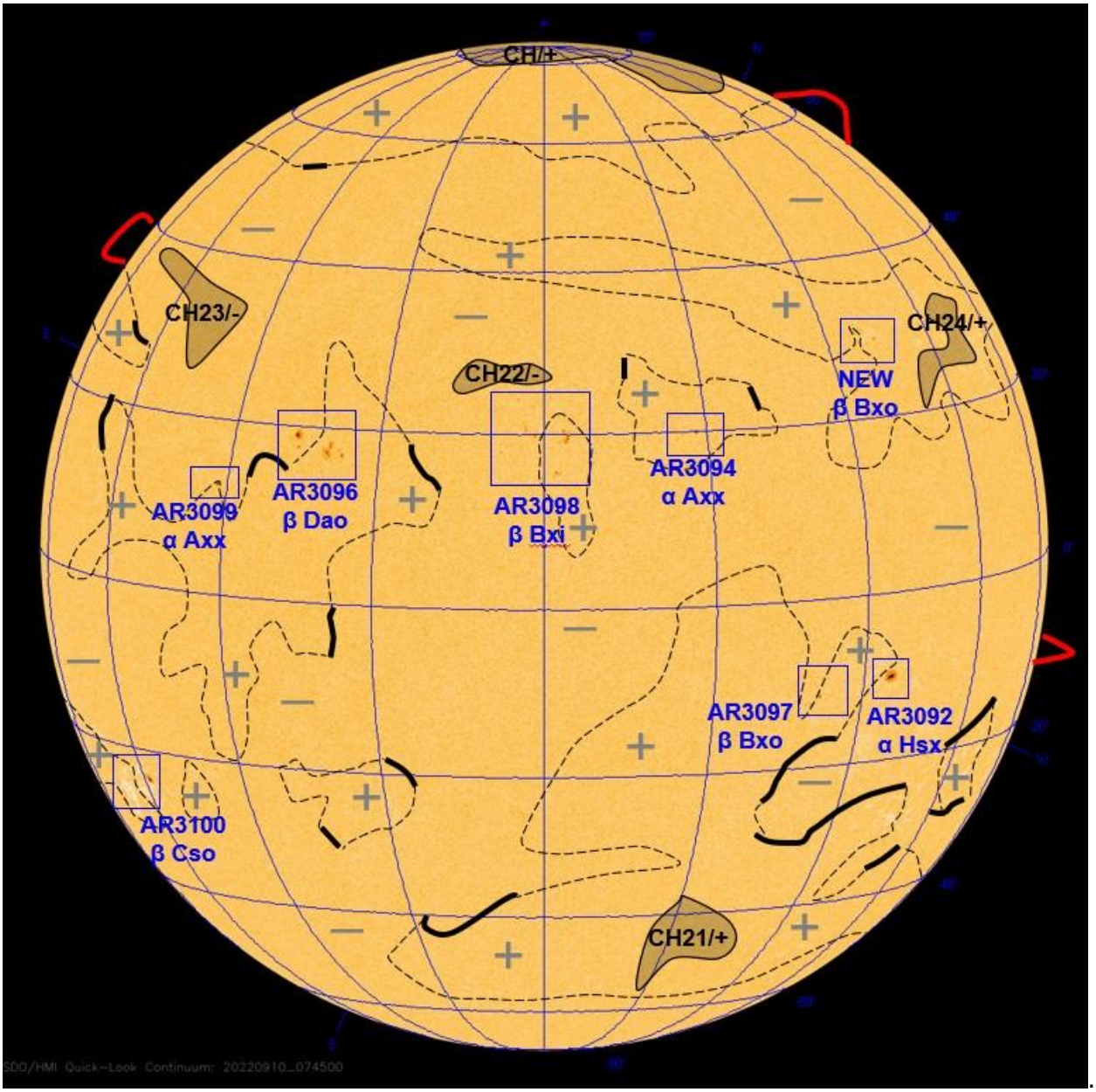
electron flux is currently at High levels and although a downward trend is expected, this likely to continue at High levels for much of the period. The corresponding 24-hour fluence is expected to see only a gradual fall through the period, but likely remaining above Active (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth directed CMEs are expected to arrive during this period, however a glancing impact is possible from the weak halo CME from the 9th September on day 5 (14th). This is very low confidence, however, and unlikely to significantly affect the forecast due to its weak nature.

Residual influence at first from CH20/+ and CH24/+ should continue to reduce through day 1 (10th), with solar winds expected to be slightly elevated to background for the forecast period. By the end of day 4 (13th) the small CH22/- could begin to enhance solar winds a little. This is more likely to influence solar winds on day 5, and any influence is likely to be weak due to its negative polarity, which is unfavoured for strong connection in autumn, and its small size. This coronal hole is the lead fragment of what was a much stronger feature on the last rotation, the main body of which appears to have closed to leave a diffuse region.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp 3) at first with a slight chance of isolated Active intervals, but trending to be predominantly Quiet (Kp 0 to 2).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/0400	Halo	Unknown	NW?	230 km/s	14th	Very low confidence. Unlikely to be observed even if Earth-directed.

Figure 2a: Solar wind persistence Model

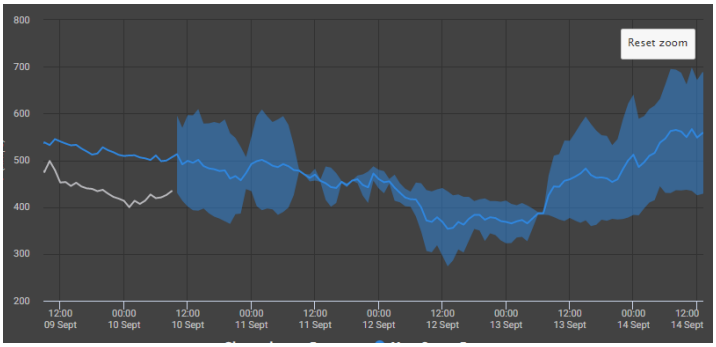

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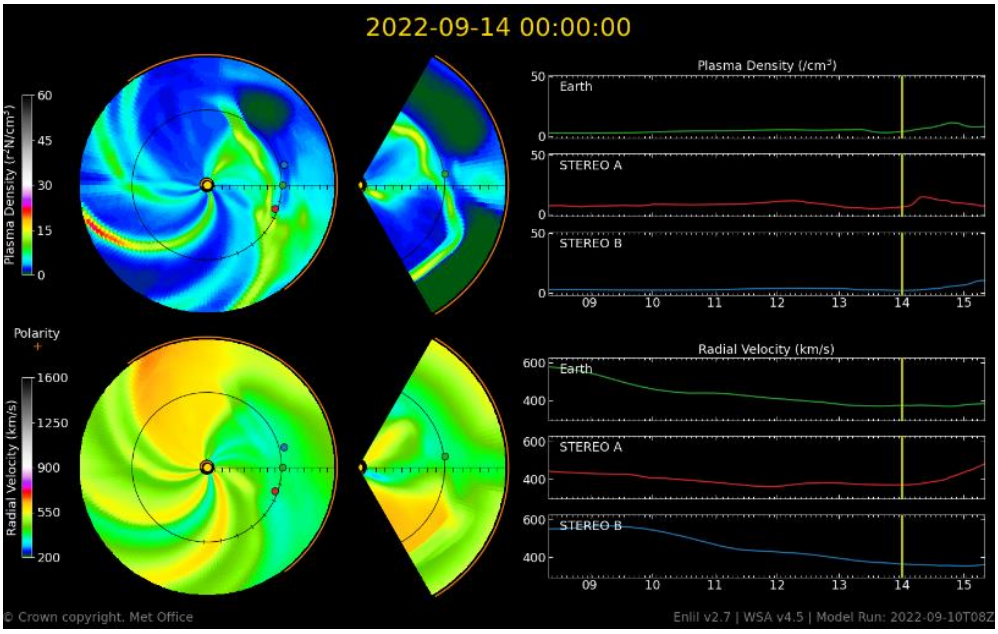
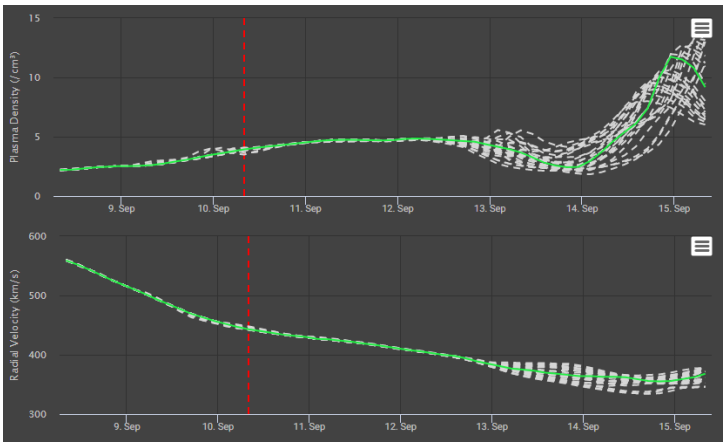
Figure 2b: Enlil and ensemble, showing very weak CME glance.





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Radio Blackouts - X-Ray Flares:
There are currently seven numbered regions and one un-numbered region on the visible disc, with Low levels of activity observed, and expected to continue through the period.
All regions remain small and simple, and the majority are either stable or decaying. The only notable growth that has been observed was amongst the recently numbered AR3100 Cso/Beta in the southeast, with some flux emergence amongst a region of plage, and also in the northwest, with recent flux emergence with a currently unnumbered and small Bxo/Beta spot. This has the potential for further development, however.
Ex-AR3088 is also due to return over the southwest limb on day 3 (12th). This was a notable region, with numerous M-flares upon leaving the Earth-facing disc, and brings a slightly increased potential for flaring from the 11th onward, as any associated looping becomes visible. This is low confidence however, as it is uncertain how much this region has evolved during its far-side transit.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3a: GOES-16/17 X-ray Flux

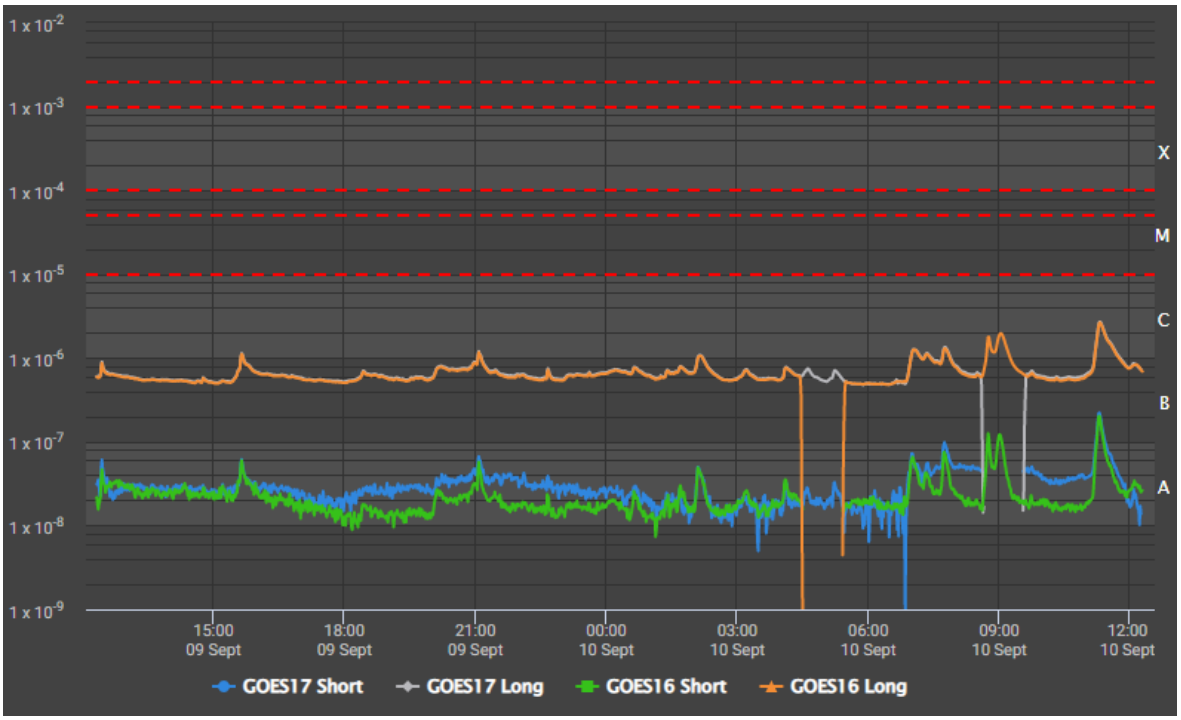

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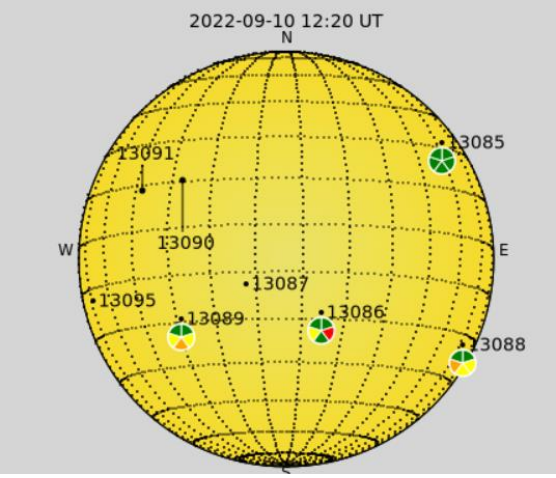
Figure 3b: Raben plot of far side, showing expected returning sunspot (left)

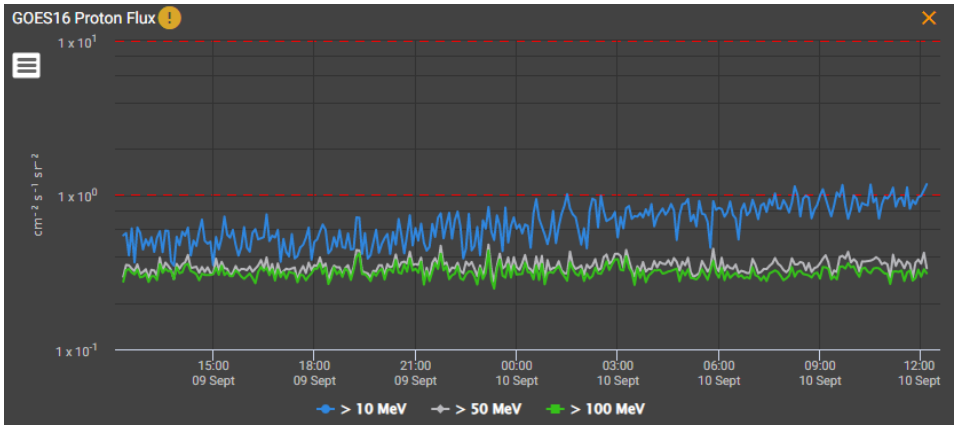


Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) observed by GOES-16 remains near Background values, but with a very slight enhancement evident. The source of this slight increase may be tied to the rearward-directed western solar hemisphere CME of 08 September, with a relatively soft onset and rise seen. Repeats of such activity are not considered likely, and little change is expected given the lack of complex regions in geoeffective locations.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-16 >10MeV >50MeV and >100 MeV Proton flux



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High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electrons have shown a significant response over recent days to the long-lasting connection to coronal hole 20 fast wind, with persistent High levels observed by GOES-16, with only an erratic decay of peak values. The levels are expected to only gradually decline through the period, perhaps falling to moderate for increasing periods at diurnal minimum.

The associated 24 hour fluence levels are expected to see a gradual fall through the period, likely persisting above the Active threshold throughout, but with an increasing chance of falling below by day 4 (13th). REFM is considered to give reasonable guidance for the overall trend through the period, but is expected to be dropping values too quickly.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	100	70	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV Electron Flux and Fluence.

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